Answers to Chapter 3 Self-Assessment Questions

(Student textbook pages 204-5)

1. c

2. a

3. d

4. e

5. d

6. a

7. e

8. d

9. c

10. a

11. a. When using a cathode ray tube and generating a potential difference across the electrodes that were in a partial vacuum, a particle was emitted from the negative electrode that was drawn to the positive electrode.

b. When the experimenter placed a magnet near the tube, the 'ray' was bent in the direction in which negative particles were known to move.

c. The same results were obtained regardless of which metal was used for the electrodes.

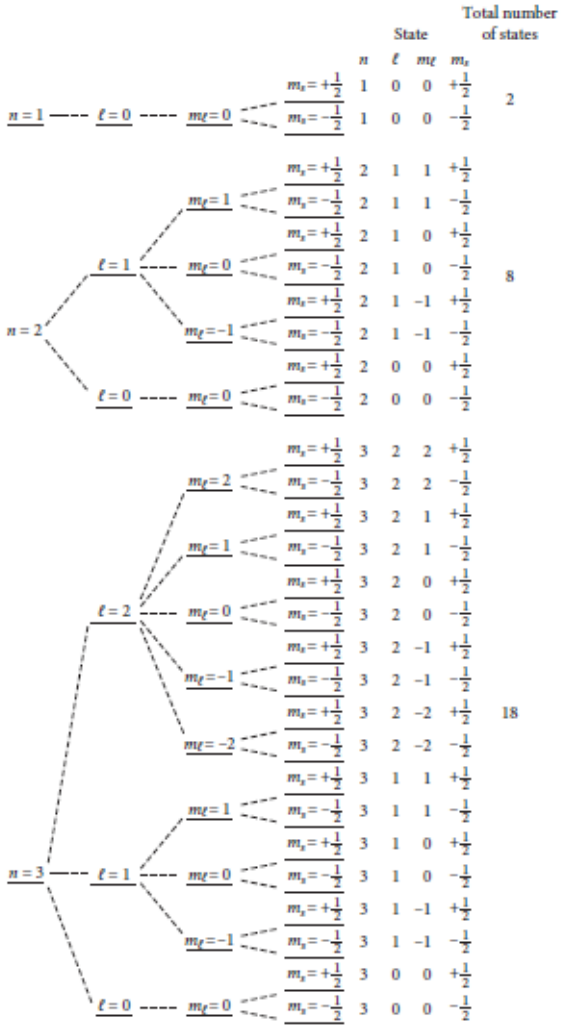
12. *Nuclear model*: When Rutherford discovered that all of the positive charge and most of the mass was located in a very small region at the centre of the atom, he called it the nucleus.
Planetary model: According to Rutherford's model, the electrons orbited the nucleus much like planets orbit the Sun.
Beehive model: Some people thought that the electrons moving around the nucleus were like bees flying around a hive.

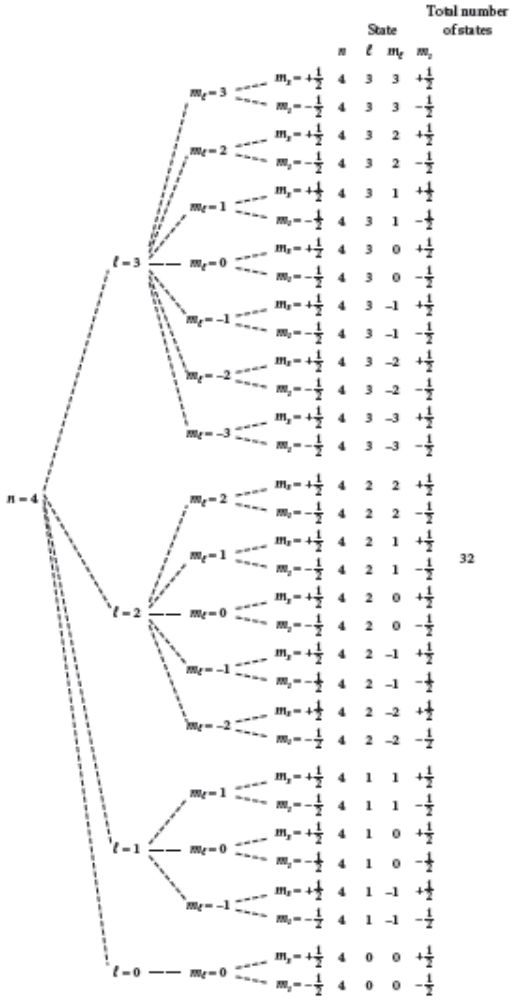
13. A continuous spectrum includes all wavelengths whereas a line spectrum contains several specific wavelengths of electromagnetic waves.

14. The symbol n generally represents an energy level in both the Bohr and quantum mechanical models. In the Bohr model, n refers to a specific allowed energy and orbit with a specific radius. In the quantum mechanical model, n refers to an energy level or shell which has sub-levels or orbitals.

15. $n = 7$; $n = 5$; $n = 4$; $n = 2$; $n = 1$: Higher numbers of n are farther from the nucleus and therefore more energy is required to pull the electron away from the nucleus.

16.





17. When light interacts with matter, it does so in discrete quantities of energy, or photons, in an all-or-nothing manner. However, when it is travelling, it exhibits wavelike properties.
Electrons have a specific amount of mass but when they travel, they exhibit wavelike properties.

18. a. m_l can be any integer from −2 to 2; five *d* orbitals

b. m_l can be −1, 0, or +1; three *p* orbitals

c. m_l must be 0; one *s* orbital

19. 1. Always fill the lowest energy level and sublevel of energy first before filling ones with higher energies.

2. Place only two electrons maximum in each orbital.

3. Fill each equal-energy orbital (orbitals with the same value of *l*) with one electron only, to half fill all of them, before adding a second electron in each one.

20. rhodium, Rh (Note: configuration should read [Kr] $5s^1 4d^8$)

21. Group 14; Period 3; *p* block

22. a. main group elements

b. transition metals or transition elements

c. inner transition metals or inner transition elements

23.
- *Bohr model only*: quantized radii for electrons; electrons move in circular orbits; no energy is emitted during orbiting; electrons can absorb energy difference between two energy levels and move to a higher energy level; could explain line spectra of hydrogen atom
- *Rutherford model only*: electrons orbit randomly in circular orbits; rotating electron is predicted to emit energy and electron should lose energy and be drawn to the nucleus; could not explain line spectra of any atom
- *Quantum mechanical model only*: electrons have wave-like and matter-like properties; quantum numbers define the characteristics of electrons in region of space called an orbital; exact position and energy of an electron cannot be known simultaneously; explains line spectra of some multi-electron atoms.
- *Bohr and Quantum model*: energy of electron is quantized; most probable position of electron is the same as Bohr's exact prediction of position; explain atomic spectra of hydrogen atom.
- *Bohr and Rutherford models*: electrons orbit the nucleus
- *Rutherford and Quantum*: nil
- *Rutherford and Bohr and Quantum*: Negative charge surrounds a central positive core; atom is a neutral species

24. The first ionization energy tends to increase across a period and decrease down a group.

25. electronegativity and electron affinity